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Kind regards,

Team Nexperia

CBTD3384

10-bit level shifting bus switch with 5-bit output enables

Rev. 8 — 12 December 2012 Product data sheet

1. General description

The CBTD3384 provides ten bits of high-speed TTL-compatible bus switching. The low ON resistance of the switch allows connections to be made with minimal propagation delay.

The CBTD3384 device is organized as two 5-bit bus switches with two separate output enable ($1\overline{OE}$, $2\overline{OE}$) inputs. When $n\overline{OE}$ is LOW, the switch is on and port A is connected to the B port. When $n\overline{OE}$ is HIGH, each switch is disabled.

The CBTD3384 is characterized for operation from −40 °C to +85 °C.

2. Features and benefits

- Designed to be used in 5 V to 3.3 V level shifting applications with internal diode
- 5 Ω switch connection between two ports
- TTL-compatible control input levels
- Multiple package options
- Latch-up protection exceeds 100 mA per JESD78
- ESD protection:
  - HBM JESD22-A114E exceeds 2000 V
  - CDM JESD22-C101C exceeds 1000 V

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
CBTD3384D	−40 °C to +85 °C	SO24	plastic small outline package; 24 leads; body width 7.5 mm	SOT137-1
CBTD3384DB	−40 °C to +85 °C	SSOP24	plastic shrink small outline package; 24 leads; body width 5.3 mm	SOT340-1
CBTD3384DK	−40 °C to +85 °C	SSOP24[1]	plastic shrink small outline package; 24 leads; body width 3.9 mm; lead pitch 0.635 mm	SOT556-1
CBTD3384PW	−40 °C to +85 °C	TSSOP24	plastic thin shrink small outline package; 24 leads; body width 4.4 mm	SOT355-1

[1] Also known as QSOP24 package

4. Functional diagram

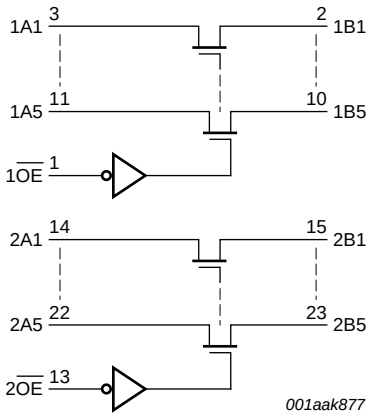

Fig 1. Logic diagram

5. Pinning information

5.1 Pinning

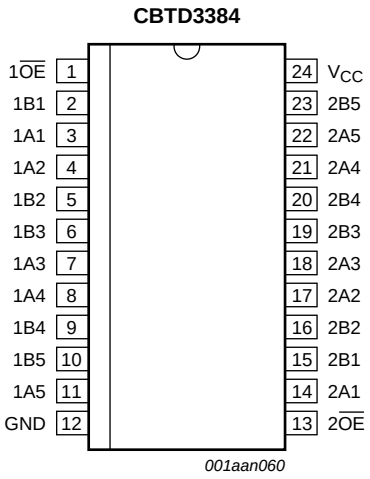

Fig 2. Pin configuration for SO24 (SOT137-1)

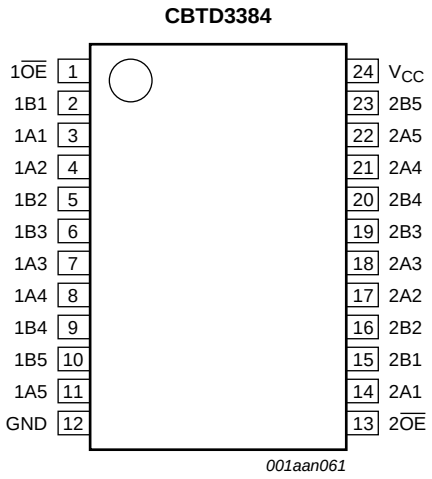

Fig 3. Pin configuration for SSOP24 (SOT340-1) and TSSOP24 (SOT355-1)

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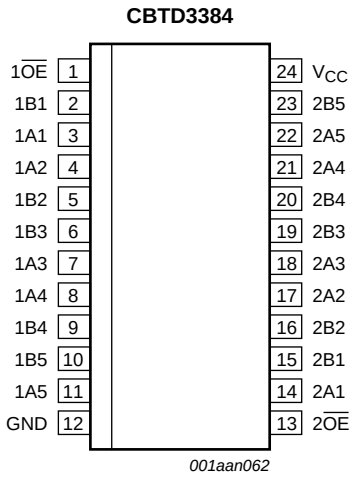

Fig 4. Pin configuration for SSOP24 (SOT556-1)

5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
1$\overline{OE}$, 2$\overline{OE}$	1, 13	output enable input (active LOW)
1A1 to 1A5	3, 4, 7, 8, 11	data input/output (A port)
2A1 to 2A5	14, 17, 18, 21, 22	data input/output (A port)
1B1 to 1B5	2, 5, 6, 9, 10	data input/output (B port)
2B1 to 2B5	15, 16, 19, 20, 23	data input/output (B port)
GND	12	ground (0 V)
V_{CC}	24	positive supply voltage

6. Functional description

Table 3. Function selection[1]

Input		Input/output	
1$\overline{OE}$	**2$\overline{OE}$**	**1An, 1Bn**	**2An, 2Bn**
L	L	1An = 1Bn	2An = 2Bn
L	H	1An = 1Bn	Z
H	L	Z	2An = 2Bn
H	H	Z	Z

[1] H = HIGH voltage level; L = LOW voltage level; Z = high-impedance OFF-state.

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7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).[1]
T_{amb} = –40 °C to +85 °C, unless otherwise specified.

Symbol	Parameter	Conditions		Min	Max	Unit
V_{CC}	supply voltage			–0.5	+7.0	V
V_I	input voltage		[2]	–0.5	+7.0	V
I_O	output current	V_O < 0 V		-	±128	mA
I_{IK}	input clamping current	$V_{I/O}$ = 0 V		–50	-	mA
T_{stg}	storage temperature			–65	+150	°C

[1] Stresses beyond those listed may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under Section 8. is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

[2] The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.

8. Recommended operating conditions

Table 5. Operating conditions

All unused control inputs of the device must be held at V_{CC} or GND to ensure proper device operation.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage		4.5	-	5.5	V
V_{IH}	HIGH-level input voltage		2.0	-	-	V
V_{IL}	LOW-level input voltage		-	-	0.8	V
T_{amb}	ambient temperature	operating in free air	–40	-	+85	°C

9. Static characteristics

Table 6. Static characteristics

Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions		T_{amb} = –40 °C to +85 °C			Unit
				Min	Typ[1]	Max	
V_{IK}	input clamping voltage	V_{CC} = 4.5 V; I_I = –18 mA		-	-	–1.2	V
I_I	input leakage current	V_{CC} = 5.5 V; V_I = GND or 5.5 V		-	-	±1	μA
I_{CC}	supply current	V_{CC} = 5.5 V; I_O = 0 mA; V_I = V_{CC} or GND		-	-	1.5	mA
ΔI_{CC}	additional supply current	per input pin; V_{CC} = 5.5 V; one input at 3.4 V, other inputs at V_{CC} or GND	[2]	-	-	2.5	mA
V_{pass}	pass voltage	see Figure 5 to Figure 9		-	-	-	V
C_I	input capacitance	control pins; V_I = 3 V or 0 V		-	3.2	-	pF
$C_{io(off)}$	off-state input/output capacitance	port off; V_I = 3 V or 0 V; $n\overline{OE}$ = V_{CC}		-	6.0	-	pF

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Table 6. Static characteristics *...continued*

Voltages are referenced to GND (ground = 0 V).

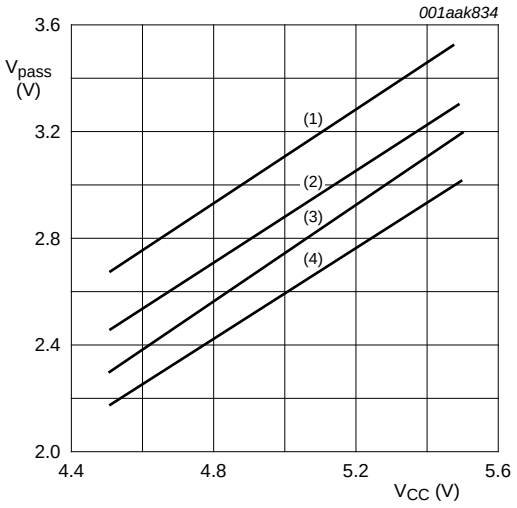
Symbol	Parameter	Conditions		T_{amb} = –40 °C to +85 °C			Unit
				Min	Typ[1]	Max	
R_{ON}	ON resistance	V_{CC} = 4.5 V; V_I = 0 V; I_I = 64 mA	[3]	-	5	7	Ω
		V_{CC} = 4.5 V; V_I = 0 V; I_I = 30 mA	[3]	-	5	7	Ω
		V_{CC} = 4.5 V; V_I = 2.4 V; I_I = –15 mA	[3]	-	17	50	Ω

[1] All typical values are at V_{CC} = 5 V, T_{amb} = 25 °C.

[2] This is the increase in supply current for each input that is at the specified TTL voltage level rather than V_{CC} or GND.

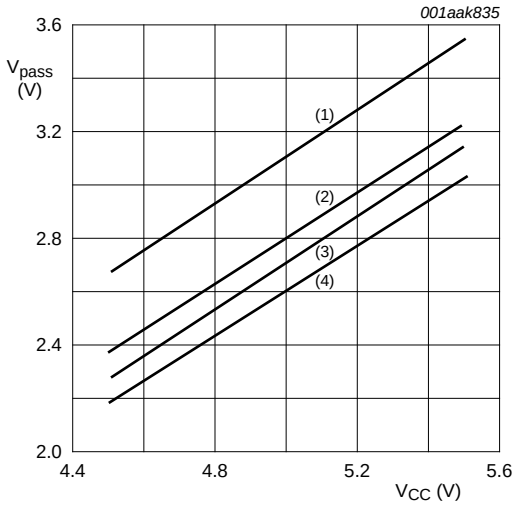
[3] Measured by the voltage drop between the nAn and the nBn terminals at the indicated current through the switch. ON resistance is determined by the lowest voltage of the two (nAn or nBn) terminals.

9.1 Typical pass voltage graphs



(1) I_{SW} = 100 μA
(2) I_{SW} = 6 mA
(3) I_{SW} =12 mA
(4) I_{SW} = 24 mA

Fig 5. Pass voltage versus supply voltage; T_{amb} = 85 °C (typical)



(1) I_{SW} = 100 μA
(2) I_{SW} = 6 mA
(3) I_{SW} =12 mA
(4) I_{SW} = 24 mA

Fig 6. Pass voltage versus supply voltage; T_{amb} = 70 °C (typical)

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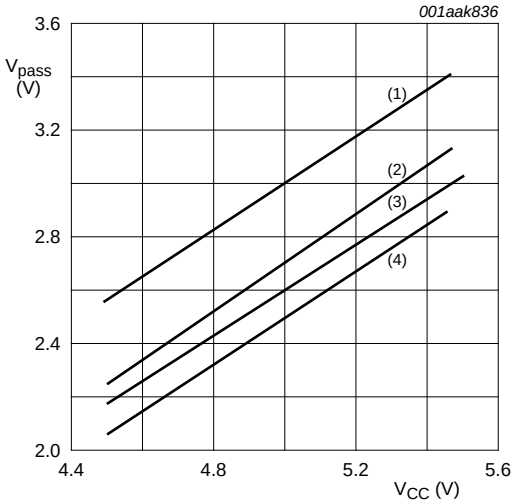
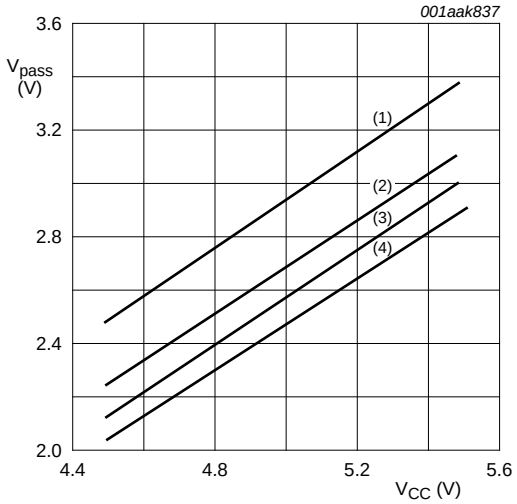


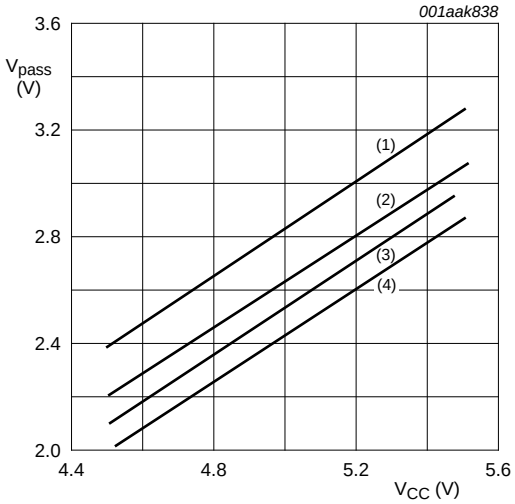
(1) I_{SW} = 100 μA
(2) I_{SW} = 6 mA
(3) I_{SW} =12 mA
(4) I_{SW} = 24 mA

Fig 7. Pass voltage versus supply voltage; T_{amb} = 25 °C (typical)



(1) I_{SW} = 100 μA
(2) I_{SW} = 6 mA
(3) I_{SW} =12 mA
(4) I_{SW} = 24 mA

Fig 8. Pass voltage versus supply voltage; T_{amb} = 0 °C (typical)



(1) I_{SW} = 100 μA
(2) I_{SW} = 6 mA
(3) I_{SW} =12 mA
(4) I_{SW} = 24 mA

Fig 9. Pass voltage versus supply voltage; T_{amb} = –40 °C (typical)

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10. Dynamic characteristics

Table 7. Dynamic characteristics

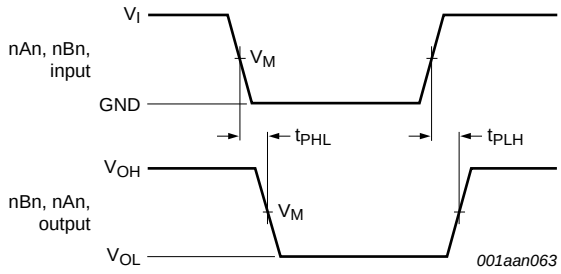
Voltages are referenced to GND (ground = 0 V). For test circuit see Figure 12.

Symbol	Parameter	Conditions		T_{amb} = –40 °C to +85 °C			Unit
				Min	Typ	Max	
t_{pd}	propagation delay	nAn, nBn to nBn, nAn; see Figure 10	[1][2]				
		V_{CC} = 5.0 V ± 0.5 V		-	-	0.25	ns
t_{en}	enable time	$\overline{nOE}$ to nAn or nBn; see Figure 11	[2]				
		V_{CC} = 5.0 V ± 0.5 V		1.2	4.3	7.0	ns
t_{dis}	disable time	$\overline{nOE}$ to nAn or nBn; see Figure 11	[2]				
		V_{CC} = 5.0 V ± 0.5 V		1.7	3.0	5.3	ns

[1] The propagation delay is the calculated RC time constant of the typical ON resistance of the switch and the specified load capacitance, when driven by an ideal voltage source (zero output impedance).

[2] t_{pd} is the same as t_{PLH} and t_{PHL}.
t_{en} is the same as t_{PZL} and t_{PZH}.
t_{dis} is the same as t_{PLZ} and t_{PHZ}.

11. Waveforms



Measurement points are given in Table 8.

Logic levels: V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig 10. The data input (nAn, nBn) to output (nBn, nAn) propagation delay times

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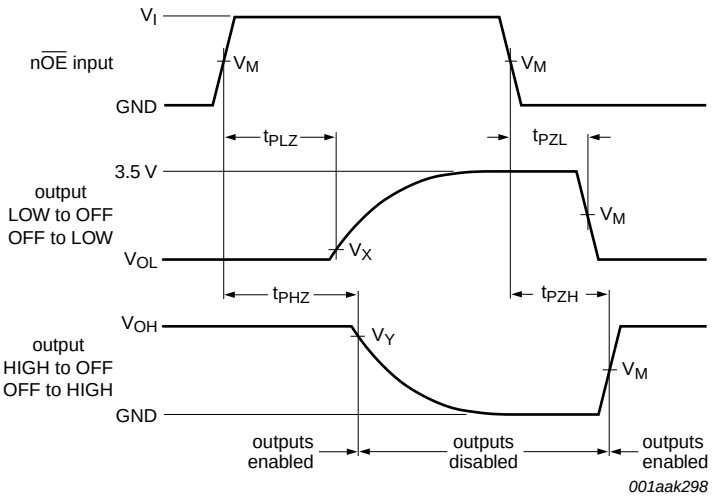

Measurement points are given in Table 8.

Logic levels: V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig 11. Enable and disable times

Table 8. Measurement points

Supply voltage	Input		Output		
V_{CC}	V_I	V_M	V_M	V_X	V_Y
V_{CC} = 5.0 V ± 0.5 V	GND to 3.0 V	1.5 V	1.5 V	V_{OL} + 0.3 V	V_{OH} − 0.3 V

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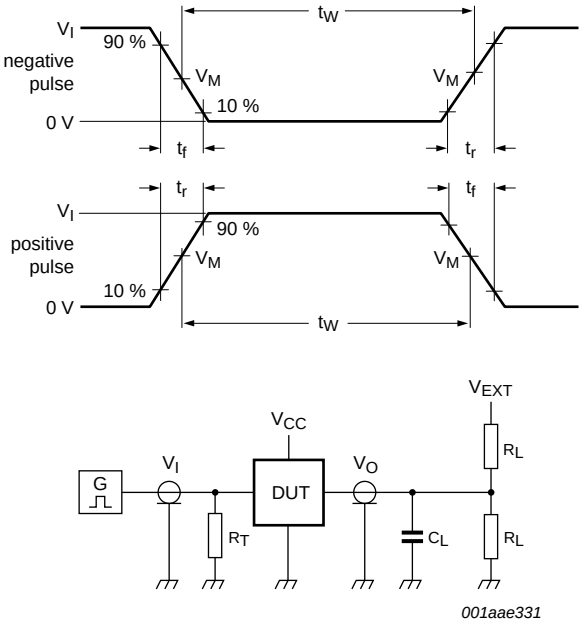
12. Test information



Test data is given in Table 9.

All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz; Z_o = 50 Ω.

The outputs are measured one at a time with one transition per measurement.

Definitions for test circuit:

R_L = Load resistance.

C_L = Load capacitance including jig and probe capacitance.

R_T = Termination resistance should be equal to output impedance Z_o of the pulse generator.

V_{EXT} = External voltage for measuring switching times.

Fig 12. Test circuit for measuring switching times

Table 9. Test data

Supply voltage	Input		Load		V_{EXT}		
	V_I	t_r, t_f	C_L	R_L	t_{PLH}, t_{PHL}	t_{PLZ}, t_{PZL}	t_{PHZ}, t_{PZH}
V_{CC} = 5.0 V ± 0.5 V	GND to 3.0 V	≤ 2.5 ns	50 pF	500 Ω	open	7.0 V	open

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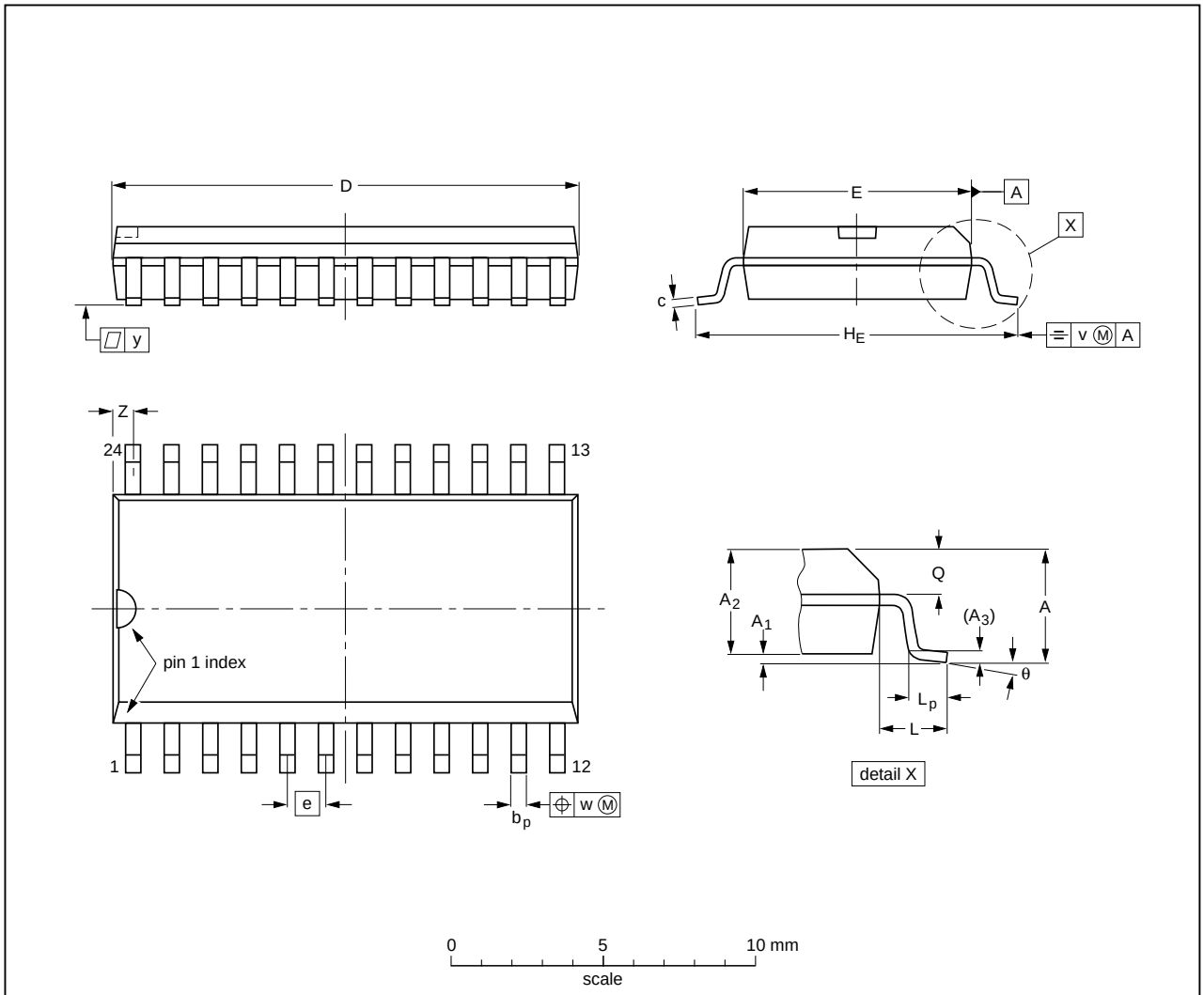
13. Package outline

SO24: plastic small outline package; 24 leads; body width 7.5 mm **SOT137-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.65	0.3 0.1	2.45 2.25	0.25	0.49 0.36	0.32 0.23	15.6 15.2	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8^o 0^o
inches	0.1	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.61 0.60	0.30 0.29	0.05	0.419 0.394	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

Note

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT137-1	075E05	MS-013				~~99-12-27~~ 03-02-19

Fig 13. Package outline SOT137-1 (SO24)

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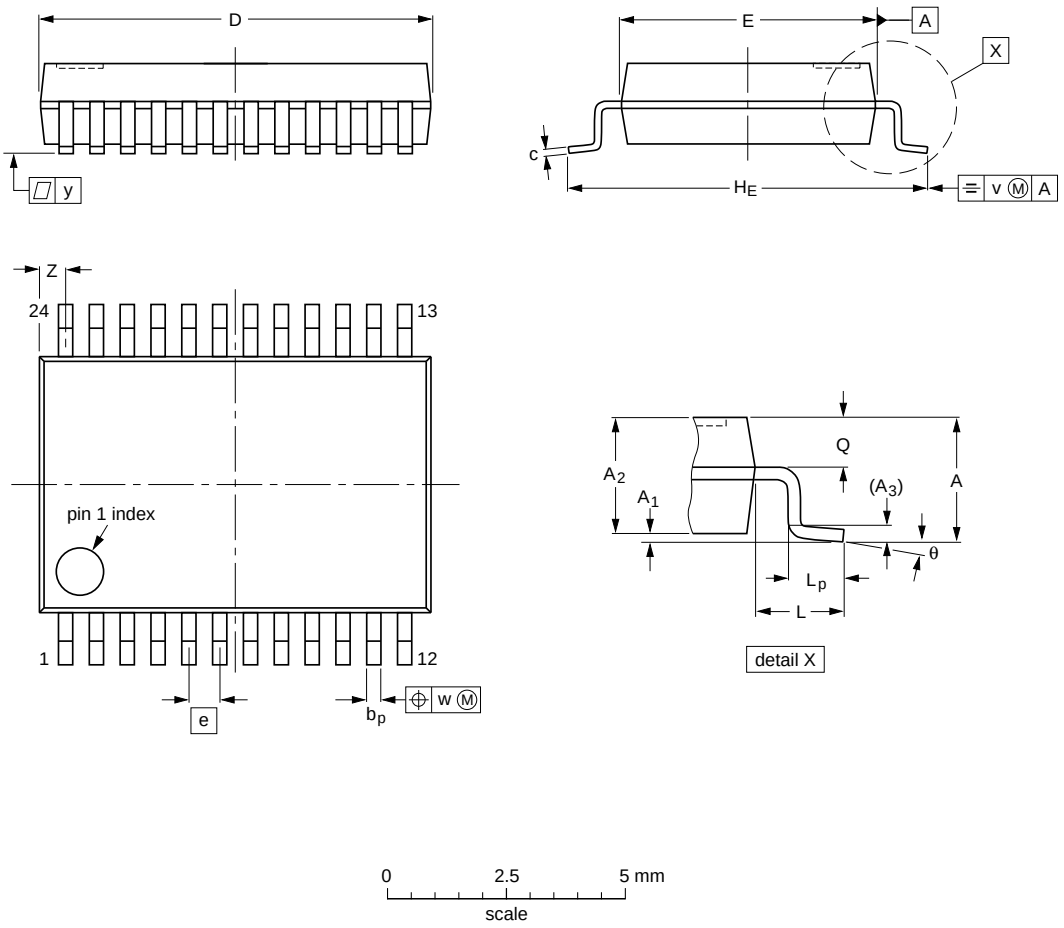
SSOP24: plastic shrink small outline package; 24 leads; body width 5.3 mm **SOT340-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	H_E	L	L_p	Q	v	w	y	Z(1)	θ
mm	2	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	8.4 8.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	0.8 0.4	8^o 0^o

Note

1. Plastic or metal protrusions of 0.2 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT340-1		MO-150				~~99-12-27~~ 03-02-19

Fig 14. Package outline SOT340-1 (SSOP24)

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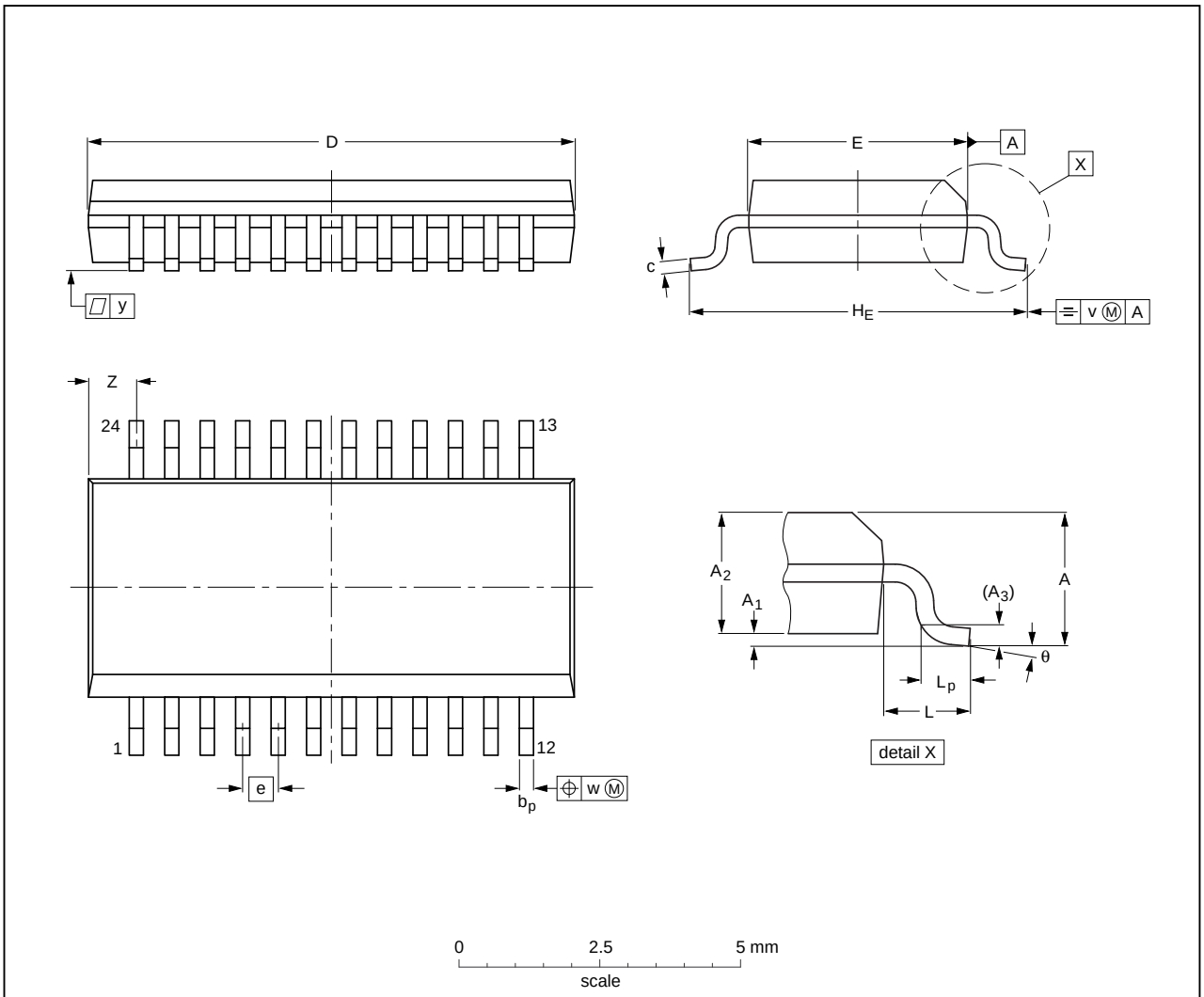
SSOP24: plastic shrink small outline package; 24 leads; body width 3.9 mm; lead pitch 0.635 mm **SOT556-1**



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	v	w	y	$Z^{(1)}$	θ
mm	1.73	0.25 0.10	1.55 1.40	0.25	0.31 0.20	0.25 0.18	8.8 8.6	4.0 3.8	0.635	6.2 5.8	1	0.89 0.41	0.25	0.18	0.1	1.05 0.66	8^o 0^o
inches	0.068	0.0098 0.0040	0.061 0.055	0.01	0.012 0.008	0.0098 0.0075	0.344 0.337	0.157 0.150	0.025	0.244 0.228	0.041	0.035 0.016	0.01	0.007	0.004	0.040 0.026	8^o 0^o

Note

1. Plastic or metal protrusions of 0.2 mm (0.008 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT556-1		MO-137				~~99-12-27~~ 03-02-18

Fig 15. Package outline SOT556-1 (SSOP24)

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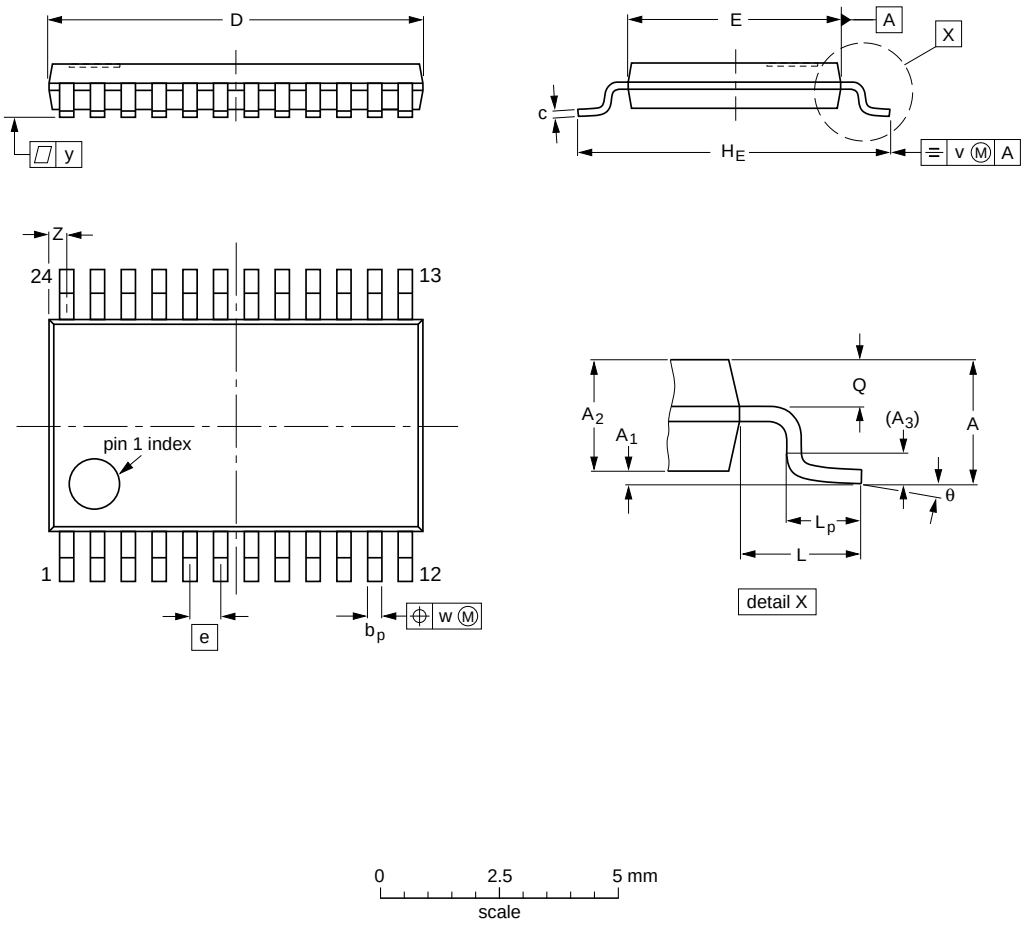
TSSOP24: plastic thin shrink small outline package; 24 leads; body width 4.4 mm **SOT355-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	7.9 7.7	4.5 4.3	0.65	6.6 6.2	1	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.5 0.2	8^o 0^o

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT355-1		MO-153				~~99-12-27~~ 03-02-19

Fig 16. Package outline SOT355-1 (TSSOP24)

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14. Abbreviations

Table 10. Abbreviations

Acronym	Description
CDM	Charged Device Model
ESD	ElectroStatic Discharge
HBM	Human Body Model
PRR	Pulse Rate Repetition
TTL	Transistor-Transistor Logic

15. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
CBTD3384 v.8	20121212	Product data sheet	-	CBT3384 v.7
Modifications:	• Table 1: changed +125 °C into +85 °C (errata).			
CBTD3384 v.7	20121119	Product data sheet	-	CBT3384 v.6
Modifications:	• Table 1: changed +85 °C into +125 °C (errata).			
CBTD3384 v.6	20111121	Product data sheet	-	CBTD3384 v.5
Modifications:	• Legal pages updated.			
CBTD3384 v.5	20101119	Product data sheet	-	CBTD3384 v.4
CBTD3384 v.4	20011220	Product specification		CBTD3384 v.3
CBTD3384 v.3	20000830	Product specification	-	CBTD3384 v.2
CBTD3384 v.2	20000830	Product specification	-	-

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16. Legal information

16.1 Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

16.2 Definitions

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